Greenhouse Gas Emissions

Background

A greenhouse gas (GHG) is an atmospheric gas that slows the rate at which heat radiates into space, thus having a warming effect on the atmosphere. GHGs include water vapor, carbon dioxide (CO_2), methane, nitrous oxide, chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs) and some other halogenated gases. Emissions of GHGs are substantially larger than emissions of other man-made pollutants. The United States alone released more than 5.5 billion tons of CO_2 from combustion in 2001; this is about 250 times the national emission of other major pollutants such as nitrogen oxides (NO_x), sulfur dioxide (SO_2), and volatile organic compounds (VOCs). Excessive CO_2 emissions have caused an imbalance in the planet's natural ability to absorb or use CO_2, resulting in steadily increasing CO_2 concentrations. According to a recent Intergovernmental Panel on Climate Change (IPCC) report,[1] up until the Industrial Revolution in the late 18th century, the amount of CO_2 in the atmosphere had remained stable for 10,000 years, and the present CO_2 concentration is higher than it had been in at least 420,000 years.

There is good evidence that the Earth's surface has warmed by 0.5 to 1.3 degrees F (0.3 to 0.7 degrees C) during the past century,[2] and the evidence for warming during the last 60 years is unequivocal.[3] Increasing temperatures have led to a reduction in the mass of the world's alpine glaciers,[4] an increase in permafrost thawing at high latitudes[5] and altitudes,[6] a reduction in the extent and thickness of Arctic sea-ice,[7] later freeze-up and earlier break-up of ice on rivers and lakes,[8] and an increase in the rate at which icebergs break off Antarctic ice shelves.[9] There is also a well-documented increase in the storage of heat near the surface of the ocean,[10] and an overall rise in sea level due in part to thermal expansion of the ocean and melting of continental glaciers.[11]

The rate of change of temperature observed in recent times corresponds closely with what appears to be an unprecedented rapid increase in the concentration of GHGs in the atmosphere, especially CO_2.[12] Rising temperatures are expected to have direct and indirect impacts on human health and the environment in New Jersey. One direct human-health impact may be increased heat stress, especially for the elderly, infants and people with cardiovascular or respiratory diseases. Climate models predict an increase in the number of days per year with temperatures above 90° F in the New York City metro area, with a potentially significant impact on human health due to heat stress.[13] By the 2020s, climate change could result in an increase of 55 percent in summer heat-related mortality and a more than doubling of the 2020 figures by the 2050s.[14] Rising temperatures are expected to exacerbate the formation of ground-level ozone, which will further challenge New Jersey's attempts to meet national ambient air-quality standards. In addition, ozone is a greenhouse gas that, like CO2, can contribute to climate change. High temperatures also facilitate the formation of fine particles, which may cause a number of health problems including premature death, aggravated asthma, labored breathing and other respiratory ailments that require emergency-room care or hospitalization. Warmer temperatures, particularly in the winter, could promote the spread of disease-carrying insects.

Natural ecosystems, water supply and agriculture also may be affected by warmer temperatures and associated changes in the water cycle. Climate-related habitat loss could lead to extinction of some threatened species. Warmer temperatures are expected to lead to more intense rain events, since warm air holds more water vapor. However, warmer temperatures also are likely to lead to greater evaporation and transpiration of moisture, which could cause drier conditions in soils. The probable impacts on New Jersey are difficult to assess; global temperature change may alter today's normal storm tracks, possibly leading to an increased number of droughts.

Sea-level rise due to climate change is of major concern to New Jersey because the state's coastline, which is densely populated, is especially vulnerable to flooding and erosion.[15] Effects of rising sea level are magnified during storm events, and higher sea levels will increase the severity of storm-related flooding in coastal and bay areas. In addition to significant property losses, sea-level rise will adversely impact coastal ecosystems and may threaten coastal freshwater supplies due to saltwater intrusion.[16]

Goals

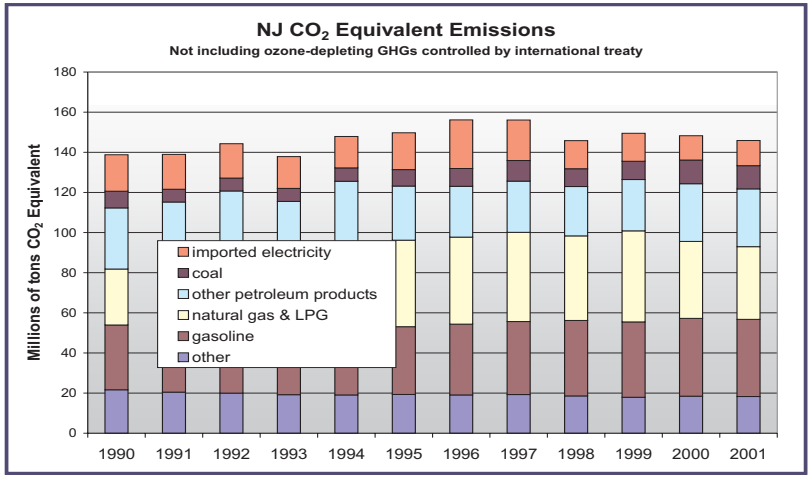
Although there is considerable uncertainty, atmospheric scientists have suggested that the global atmospheric concentration of CO_2, currently increasing at about 0.5% per year, must be held below 550 ppm in order to avoid climate disruption that could significantly alter ocean circulation patterns.[1] Alteration of ocean circulation patterns could conceivably bring about a rapid swing of the climate to a new regime that could be widely disruptive. To keep the atmo-

spheric concentration below 550 ppm, global anthropogenic emissions must be reduced by at least a factor of five very soon. A comparison of the necessary reductions with continued increases of emissions, such as are projected for NJ (as well as virtually all other governmental units in the industrialized world), emphasizes that both major new mandatory reduction programs and measures to adapt to climate change are called for.

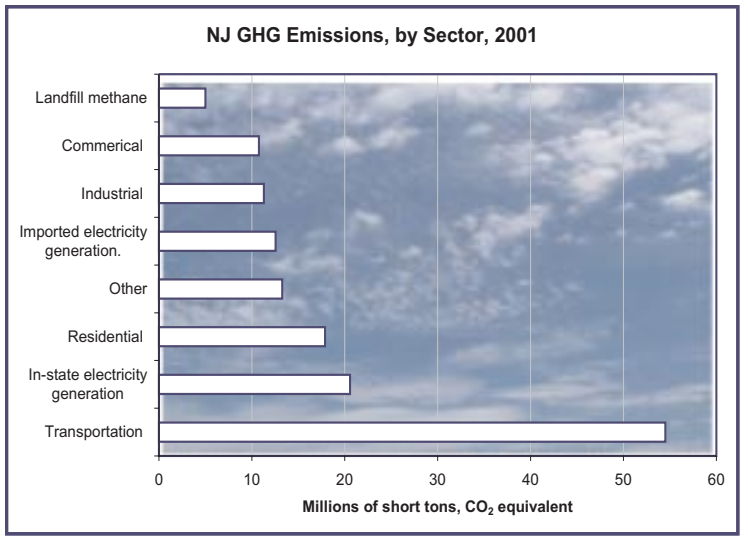
Status and Trends

The DEP's Division of Science, Research, and Technology estimates New Jersey GHG emissions based on data on fuel consumption received from the U.S. Department of Energy, Energy Information Administration (EIA).[18]

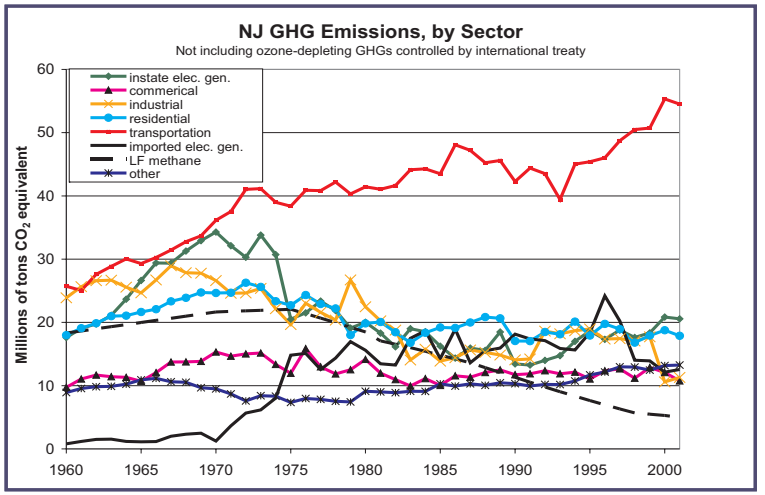
The revised GHG emission estimates since 1990 are shown in the chart "NJ CO_2 Equivalent Emissions, below." CO_2 equivalent data include emissions of methane and other GHGs weighted by their global warming potential and expressed in terms of CO_2.

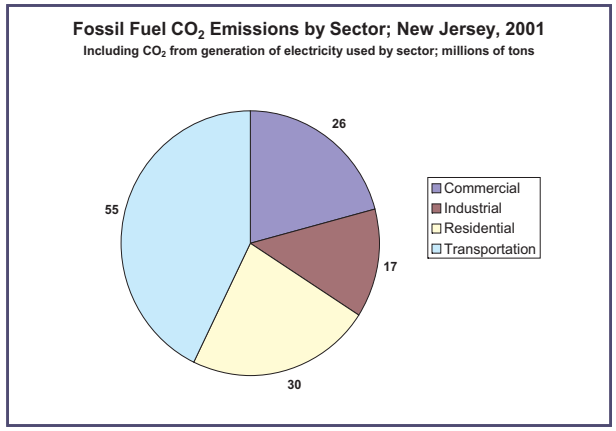


The chart above indicates that more than 85 percent of New Jersey's emissions are produced by burning of fossil fuels (coal, oil and natural gas).



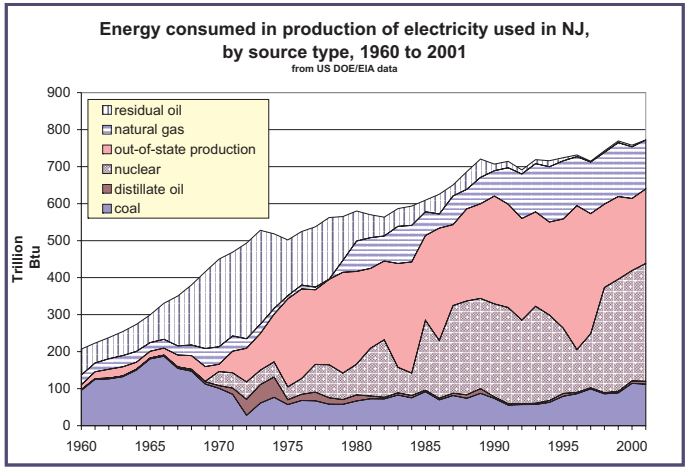
The chart "NJ GHG Emissions, by Sector, 2001" shows the transportation sector contributes more than 50 million tons of CO_2 equivalent emissions per year. According to the chart below, the transportation sector also has shown consistent growth between 1960 and 2000.





Emissions from the sectors in the following chart, including the emissions from electricity generation, once again show that transportation generates the highest proportion of CO_2. Although declining briefly in the early 90s, the transportation sector's emissions have shown a long-term increase of about 2 percent per year since 1960. Transportation sector emissions have increased rapidly since the mid-1990s, for an overall rate of increase since 1990 of 3 percent per year. Both the consistent increase in the number of vehicle miles traveled per year and recent declines in efficiency of the light-duty vehicle fleet (cars, pickup trucks, and sport/utility vehicles) have led to the increased emissions. No current programs appear capable of stemming the projected continued growth of emissions from this sector.

The electricity generation sector's energy use has shifted over the years. Recent trends include the use of much more nuclear power and natural gas, which are lower GHG sources, and a reduction in the amount of residual fuel oil (a relatively higher source of GHGs). (See the chart "Energy consumed in production of electricity used in NJ,…" above).[19]



Outlook and Implications

GHG emissions will be reduced by increased energy efficiency and conservation, and the replacement of fossil-fuel energy with renewable energy sources. New Jersey has several initiatives administered by the Board of Public Utilities (BPU) that are designed to meet the goal to supply all new electricity demand with renewable sources and energy-efficiency measures by 2012. The NJ Clean Energy Program, which is widely considered one of the largest and most ambitious energy-efficiency programs in the nation, encourages installation of energy-efficient and renewable electricity generation technologies. The Renewable Portfolio Standard (RPS) requires electricity providers to provide 6.5 percent of electricity from renewable resources such as solar, wind or geothermal by 2008. Additional efforts are under way, including implementation of a cap-and-trade program developed through the Northeastern and Mid-Atlantic States' Regional Greenhouse Gas Initiative (RGGI) that would include, at a minimum, a cap on carbon dioxide emissions by electricity producers in the region. (See the chapter "Energy Use and Renewable Energy Sources" elsewhere in this Environmental Trends series).

Despite these measures, the rate of growth in renewable energy will have to be more than 100 times larger than its current growth rate if renewable energy sources are to even keep pace with expected growth in energy demand. Growth will have to be larger still if renewable sources are to replace current fossil and nuclear sources. Unless New Jersey can dramatically increase the pace of introduction of renewable energy sources, or make great improvements in energy efficiency and conservation, or both, it is likely that the state will remain largely dependent on nuclear energy and fossil fuels. Without increased renewable sources and energy efficiency, it also appears likely that greenhouse gas emissions will increase.

More Information

For more information, visit the DEP's Bureau of Sustainable Communities and Innovative Technologies Web site at www.state.nj.us/dep/dsr/bscit.htm, BPU's Web site www.njcleanenergy.com/index.html, the the EPA's Web site http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html, or the U.S. Department of Energy, Energy Information Administration's site, www.eia.doe.gov. For more information about the Regional Greenhouse Gas Initiative (RGGI), visitwww.rggi.org.

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[18] http://www.eia.doe.gov/emeu/states/_states.html.

[19] These data include significant revisions to the EIA data; see footnote above and discussion in text.